Space Weather Technical Forecast

Issued on Wednesday, 01 February 2023 at 01:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant geomagnetic activity expected. Slight chance of M-class flares throughout.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low, with one significant flare from AR3207 which is currently close to the southeast limb. AR3207 is one of five sunspot regions on the visible disc, with all of these magnetically simple regions, four bipolar and one unipolar. Three regions are in the west, with three regions in the southeastern quadrant. There is evidence of a weak CME leaving the southern hemisphere of the Sun early on 31 January, but there is not currently enough imagery to carry out a sufficient analysis of the feature. No further Earth-directed CMEs have been identified on satellite imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 has averaged around 450-500km/s under the influence of a high speed stream, most likely from coronal hole 72, with brief peaks above 500km/s. Solar wind density was around or slightly above average. Total magnetic field, was disturbed and varied between weak and moderate levels until 31/1700UTC due to the after effects of a high speed stream connection, but has become steadier and consistently weak since that time. The north-south component, Bz, has varied between weakly positive and negative orientations, but with a slightly negative bias. Phi angle was predominantly negative (towards the Sun) throughout. Geomagnetic activity was generally Quiet, with one Unsettled interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has been at background levels throughout. High energy electron flux (greater than 2MeV) at GEO has been at mainly background levels. Electron fluence followed a declining trend, falling to 2.85e6 integrated pfu by 01/0001UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly Low, with no significant sunspots on the visible disc and none due to rotate around from the farside. There is a very slight chance of M-class flaring based on the configurations of the visible regions.

Solar Wind / Geomagnetic Activity: A glancing CME may affect the Earth during 03 February, but with low confidence. The high speed stream from coronal hole 72, which is producing speeds in the region of 450-500km/s is likely to have declined to background by 03 February, with a further high speed stream perhaps connecting during 02 February. Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a slight chance of G1/Minor Storms on 02 and 03 February due to a new high speed stream and potential CME respectively.

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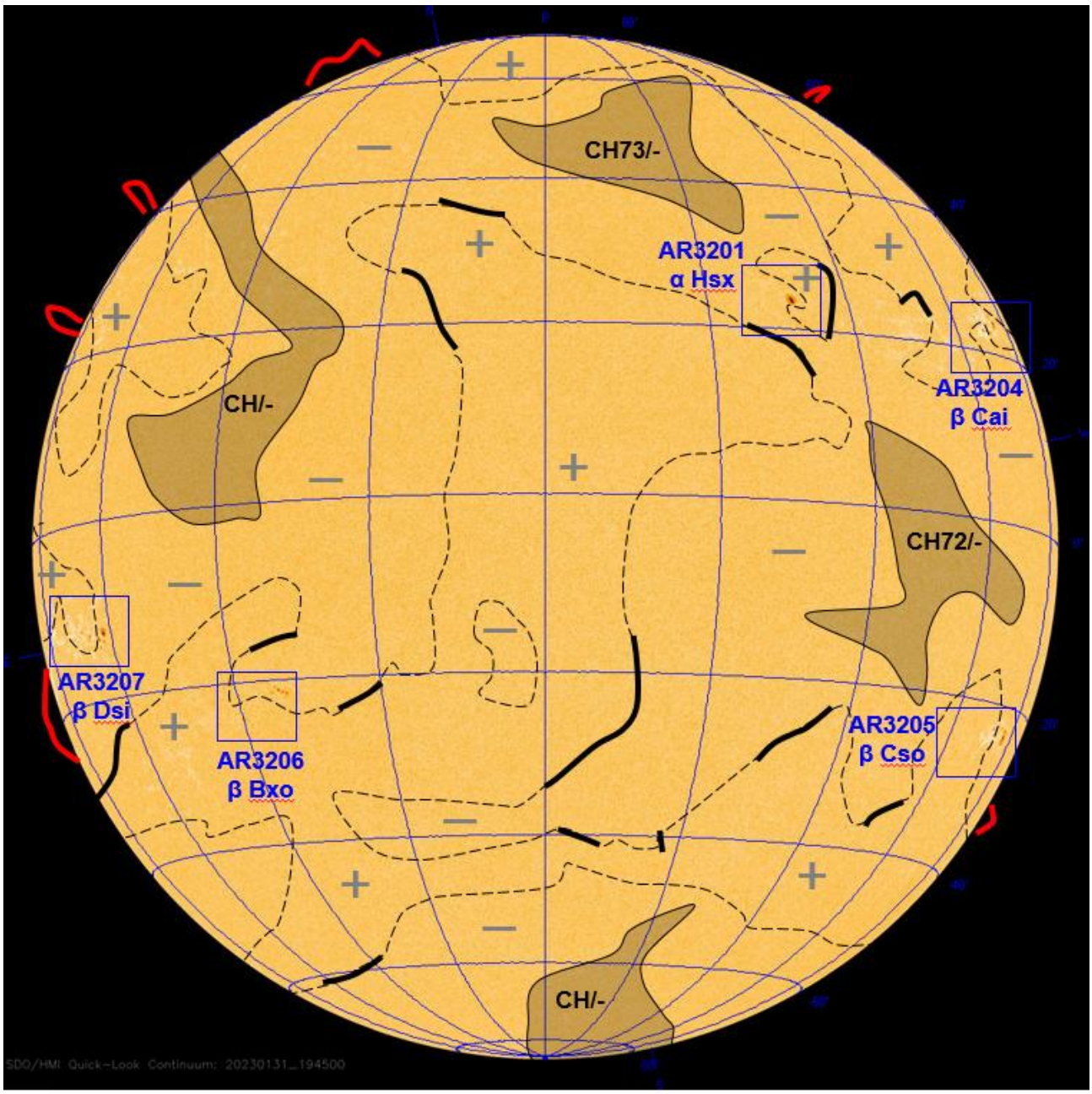
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at background levels. Electron flux may start to increasingly exceed the high threshold through the period, although this is dependent on the effects of any geomagnetic activity. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 31/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is the risk of a CME glancing the Earth, perhaps during 03 February. This is from an eruption from the northwest quadrant on 30 January, although this is low confidence as the imagery used for modelling was difficult to interpret.

Earth appears to be under the influence of coronal hole 72, with a weak area of magnetic field ahead of the main portion of the hole. This may be masking a larger feature and could explain why the high speed stream onset was earlier than forecast. The influence of this hole is expected to continue through to at least 03 February. STEREO A data is currently signaling a density rise, which could either be the result of a further coronal hole connection, or from a CME. A more accurate determination will be made as more data becomes available. Given the uncertainty in the nature of this increase, a slight chance of G1/Minor storms has been added to the forecast on 02 February as STEREO A is one day ahead of Earth.

Geomagnetic activity is expected to be mainly Quiet to Unsettled, with the slight chance of Active or G1/Minor Storm intervals on 02 February due to feature which is currently connecting to STEREO A, and which should connect with Earth within the next 24 hours. There is a further slight chance on 03 February due to a possible, but low confidence, passing CME glance.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
31/0416	Partial	Filament eruption	Unknown, possibly NW quadrant	350km/s	03/1800UTC +/-6 hours	Low confidence. Possible glancing blow.

Figure 2: 24 hour solar wind parameters

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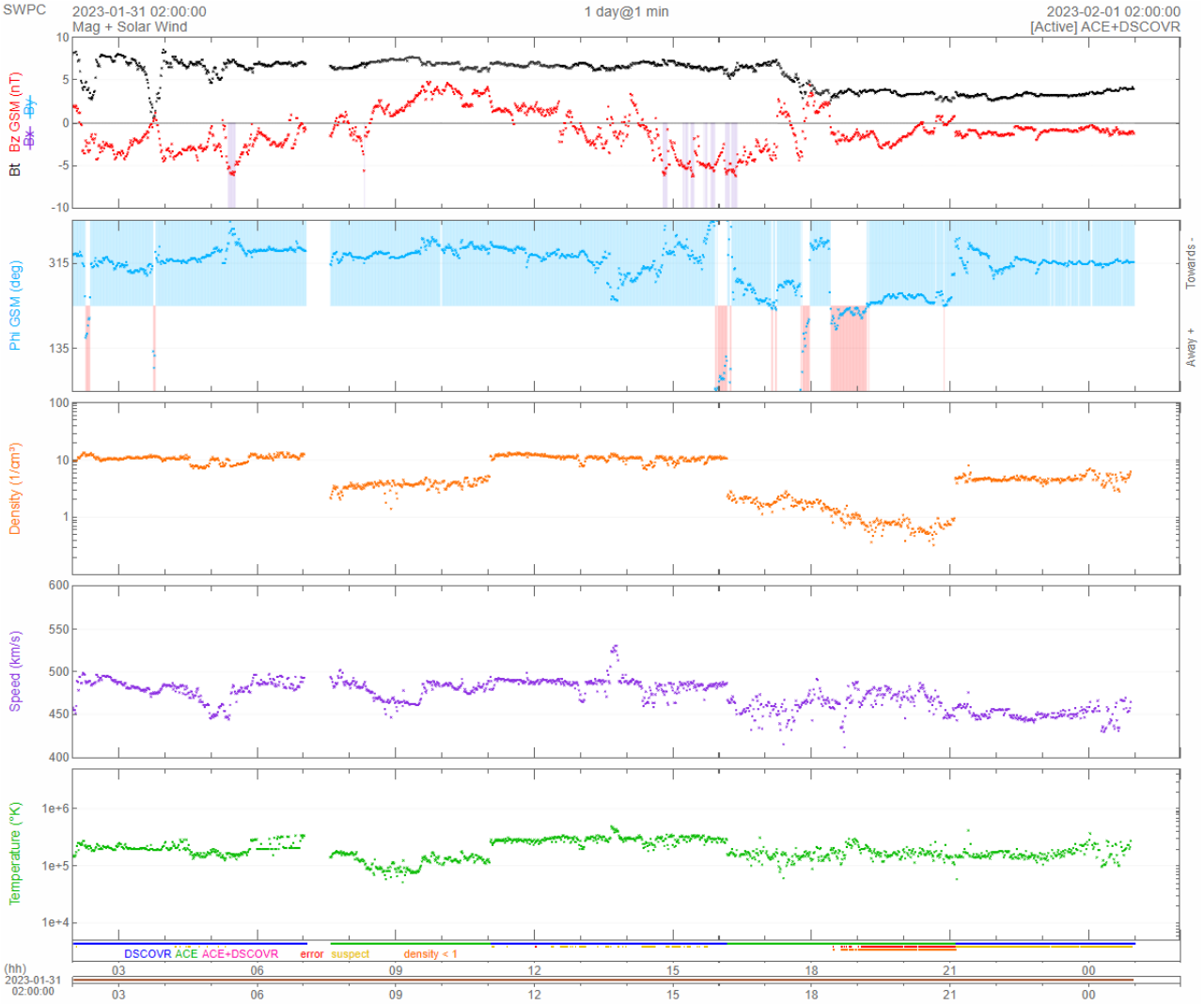

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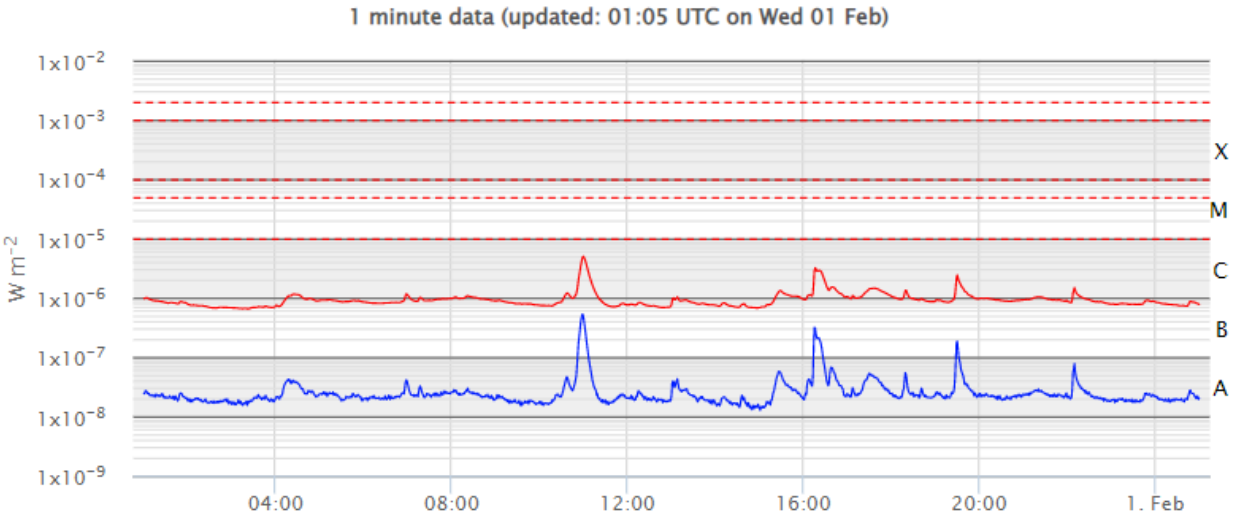
Radio Blackouts - X-Ray Flares:
There are five sunspot regions on the visible disc, with all of these relatively inactive. Helioseismology reveals the potential for a number of previously active regions to rotate across the eastern limb through the next four days, However there has not been evidence of much activity from the farside and therefore do not affect the probabilities.

Mainly Low solar activity is expected, with a slight chance of M-class flares.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux as observed by GOES16 is currently expected to persist at background levels. None of the sunspots in or due to rotate into the western hemisphere carry a significant proton storm risk.

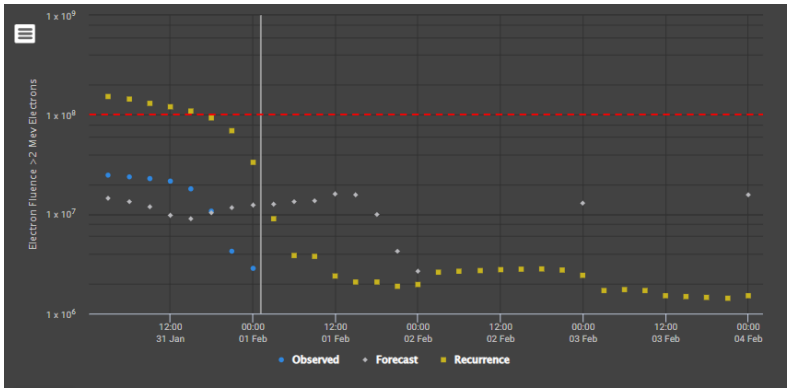
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is at background levels, but is expected to increasingly oscillate between moderate and high levels through the next four days, due to the input from the high speed stream which has been affecting the Earth. Any rise may be suppressed by potential geomagnetic activity on 02 and 03 February but this aspect of the forecast is considered low confidence. Electron fluence is at low levels with any rise over the next four days expected to be modest. The Active (1e8 integrated pfu) threshold is not expected to be reached.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM model, showing the downturn in calculated fluence and fluence forecast



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